On Some Fundamental Properties of P2P Push/Pull Protocols

Renato Lo Cigno\textsuperscript{1}, Alessandro Russo\textsuperscript{1}

Damiano Carra\textsuperscript{2}

\textsuperscript{1}DISI - University of Trento

\textsuperscript{2}Institut EURECOM

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Outline

1 Introduction
   - Media Streaming
   - Peer-to-peer Solution

2 Interleave protocols
   - Interleave Protocol
   - Interleave Implementation
   - Results

3 Conclusion
   - Summary
### Media Streaming

Enables live or on-demand distribution of multimedia content on the Internet: the problem is delivery of large amount of data with timing and quality constraints to many users

- Video on Demand (VoD)
- Live Streaming

**Goal:** design a content distribution system which can scale with the number of participants
Peer-to-Peer Systems

Peer-to-peer Paradigm
Promises to solve the most critical problems in large scale streaming systems, exploiting the sharing principles of P2P networks

- Media content is divided in pieces or stripes and distributed among participants which collaborate between them
Background

- Peers strategies
- Peers overlay scope
- Peers transfer mechanisms
- Peers organization
Interleave protocols are mesh-based swarming systems

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Interleave protocols are mesh-based swarming systems
Possible Protocols

- One-sided pull protocols fail to exploit the potential of multiple path delivery
- One-sided priority push protocols tend to leave behind older chunks

*These two distribution strategies may be integrated in order to combine their good properties*
Overlay Management

- **Fixed size neighborhood**
- Random Active Peer Selection in neighborhood
- Symmetric or Asymmetric neighborhood
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The Protocol

- Pieces are numbered 1, 2, \ldots;
- Odd time slot:
  - Source pushes new piece;
  - Every other node pushes the highest numbered piece;
  - Piece with higher identifier obtained in the previous time slot is not chosen for transmission.
- Even time slot:
  - Every user sends a pull request for the lowest numbered piece;
  - Users do not distinguish pieces based on whether they were received in even or odd time slots.
Simulator Model

- PeerSim Simulator
  - Modularity;
  - Support of millions of nodes;
  - Peers dynamism;
  - Two simulation engines: synchronous and asynchronous;
  - Familiarity with java programming.

- Engines:
  - Synchronous model;
  - Asynchronous model.

- Overlay
  - Symmetric;
  - Asymmetric.
Asynchronous Model
Asynchronous Model (cont)

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CDF Completion Time - Symmetric and Asymmetric Overlay

Figure: Cycles (after last piece was pushed by the source)
Fraction of Push operations

**Figure:** CDF of the overall download time \((k = 16; c = 5 \cdot 10^3;\) upload bandwidth: 256kbit/s
CDF PUSH Operations - Symmetric and Asymmetric Overlay

sim. type / #nodes
  event / 500
  event / 1000
  cycle / 500
  cycle / 1000
CDF Maximum Delay - Symmetric Overlay

- upl bw / #nodes
  - 256 / 100
  - 256 / 500
  - 256 / 1000
  - 512 / 100
  - 512 / 500
  - 512 / 1000

Max Delay (s)

Number of pieces

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Media streaming: P2P matches media streaming resource requirements
- Interleave Protocol and its simple mechanisms
- Work: from a simple synchronous model to a more real asynchronous model
- Results for homogeneous scenarios in static network.

Next step:
- heterogeneous Network
- bandwidth fluctuation
- peer dynamism

Assumptions:
- all nodes contribute to file distribution
- concerning malicious peers
- free riders
- incentives for distribution

FEC or MDC codes to restore content with a subset of chunks
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Thanks

Q & A?